

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

Comet and Asteroid Dynamics

PERFORMING ORGANIZATION

Jet Propulsion Laboratory
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INVESTIGATOR'S NAME

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DESCRIPTION (a. Brief statement on strategy of investigation; b. Progress and accomplishments of prior year; c. What will be accomplished this year, as well as how and why; and d. Summary bibliography)

a. **Strategy:** In order to provide observers with accurate ephemerides of comets and asteroids, up-to-date astrometric positions must be used to improve the existing orbits. For active comets, nongravitational forces must be taken into account; these forces are assumed due to the rocket-like effect of outgassing cometary ices and are used to characterize the volatility and rotation properties of icy cometary nuclei. In an effort to improve ephemeris accuracies, the benefits of a new nongravitational force model for comets as well as new radar data types are being investigated.

b. **Accomplishments:** The first successful attempts to improve the orbits of close Earth approaching asteroids using radar data have been completed for asteroids 1982XB and 1986JK. The radar Doppler measurements of 1982XB, made on Dec. 5-6, 1987, were represented to less than 0.1 Hz while the Doppler observations of 1986JK, made on May 28 - June 1, 1986, were represented to within a few Hz for each of the 11 measurements. Last minute orbit updates for asteroid 324 Bamberga allowed a successful stellar occultation prediction to be made on Dec. 8, 1987. A new paradigm for the cometary nongravitational force model has been successfully tested on a few comets. This new model allows the water vaporization curve to peak on either side of perihelion, thus introducing a nongravitational force via an asymmetric radial force, rather than through a symmetric transverse effect that the old model requires. Preliminary results suggest that the optimum locations of the water vaporization peak, required for the nongravitational forces, aligns with the locations of the visual light curve peaks.

c. **Anticipated Accomplishments:** The new orbit determination techniques will be used to compute additional "radar" orbits for close Earth approaching asteroids. The new nongravitational force model paradigm will be applied to additional comets whose light curves are asymmetric with respect to perihelion.

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d. Publications

Belton, M.J.S., Spinrad, H., Wehinger, P.A., Wyckoff, S., and Yeomans, D.K.: The Spectral Behavior of P/Halley at Large Heliocentric Distances in Light of the Giotto/Vega Results. *Astronomy and Astrophysics*, 187, 569, 1987.

Yeomans, D.K., Ostro, S.J., and Chodas, P.W.: Radar Astrometry of Near-Earth Asteroids. *Astronomical Journal* 94, 189, 1987.

Yeomans, D.K. and Keesey, M.S.: Orbit for Minor Planet 1981 Midas. *Minor Planet Circular* 12194, dated Sept. 7, 1987.

Yeomans, D.K.: Orbits for Asteroids 243 Ida, 951 Gaspra and 2825 (1938 SD1). *Minor Planet Circular* 12687, dated Jan. 4, 1988.